Accounting for Incomplete Pass-Through

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Theoretical Explanations for Incomplete Pass-Through:

- Oligopolistic mark-up adjustment

- Local Costs
  - Sanyal and Jones (1982), Burnstein et al. (2003), Corsetti and Dedola (2004), Goldberg and Campa (2006)

- Dynamic Factors - Barriers to price adjustment such as menu costs, pre-determined prices etc.
Pass-through in the Coffee Market

- Coffee is world’s second most traded commodity (after oil)
- Coffee commodity costs are highly volatile: lost almost 2/3 of value over 2000 – 2002
  - Volatility driven by weather, planting cycles, new entrants
- Industry estimates suggest that green bean coffee (imported input) accounts for more than half of marginal costs
Outline

- Document facts about pass-through
- Develop structural pricing model
- Can the model “account” for the observed degree of incomplete pass-through?
- How important are mark-up adjustment, local costs, menu costs?
Terminology

Retail Price: Supermarket price

Wholesale Price: Manufacturer Price (i.e. Folgers, Maxwell House etc.)

Coffee Commodity Price: Index of green bean coffee on New York physicals market
Data on Coffee

- Retail price data: AC Nielsen monthly average prices and sales by UPC for ground (supermarket) coffee in 50 major US markets
- Wholesale price data: Promodata weekly UPC-level prices in up to 30 US markets (varied time periods)
  - Data collected from largest wholesaler in a given market
- Other data: Advertising data (AdDollars Database), Weather
1. Cost Pass-Through Regressions

\[ \Delta \log p_{jmt} = a + \sum_{k=1}^{6} b_k \Delta \log C_{t-k} + \sum_{k=1}^{4} d_k q_k + \epsilon, \]

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\[ p_{jmt} \]: Price per ounce of ground coffee

\[ C_t \]: Commodity cost per ounce of ground coffee

Define long run pass-through as \( \sum_{k=1}^{6} b_k \)

Specification motivated by the fact that a unit root cannot be rejected for commodity costs (Goldberg and Campa, 2006)
Cost Pass-Through Regressions

- 1% increase in coffee commodity index yields long-run 0.3% increase in wholesale and retail prices
- Approximately cent-for-cent pass-through in levels
- More than half of pass-through occurs in the quarters after a change in cost
2. Retail versus Wholesale Pass-through

\[
\Delta p^r_{jmt} = \alpha^r + \sum_{k=0}^{2} \beta^r_k \Delta p^w_{jmt-k} + \sum_{k=1}^{4} \gamma^r_k q_k + \epsilon,
\]

- IV Regression: commodity costs as instruments (motivated by measurement error in wholesale prices)
- Find that retail prices adjust rapidly and approximately cent-for-cent to changes in wholesale prices
- Delayed pass-through occurs almost entirely at the wholesale level
3. Price Rigidity

Annual frequency of price change in all markets (1997-2005):

   Wholesale prices: 1.3 times per year

   Retail Prices (without sales): 1.5 times per year

   Retail prices (with sales): 3.1 times per year

Similar pattern in price rigidity to what we observe in aggregate US micro-data (Nakamura and Steinsson, 2007)
Price Change Frequency vs. Commodity Cost Volatility

![Graph showing the relationship between annual frequency and volatility. The x-axis represents volatility ranging from 0.00 to 0.03, and the y-axis represents annual frequency ranging from 0 to 5. The graph includes several data points represented by diamonds.](image-url)
Summary:

- Long-run pass-through is about 0.3
- More than half of pass-through occurs in the quarters after the cost shock
- Delayed pass-through occurs almost entirely at the wholesale rather than the retail level
- Wholesale prices adjust infrequently; more frequent adjustment when commodity costs are volatile
Potential empirical issues:

1. Do rigid wholesale prices actually determine retail prices?

   Since manufacturers and retailers interact repeatedly, wholesale prices may not be “allocative” (Barro, 1977)
   - No evidence that retail prices adjust to commodity costs above and beyond adjustments in wholesale prices

2. Do commodity costs reflect marginal costs?

   What if manufacturers enter hedging contracts or long-term purchasing contracts?
   - Hedging contracts etc. affect the average cost, but not the marginal cost of coffee beans
Overview of Structural Model

Demand

- Random coefficients discrete choice model (BLP, 1995)
- Estimate using data on prices, market shares
- Identify consumer heterogeneity using market shares for particular demographic groups

Supply

- Oligopoly menu cost model
- Multi-product asymmetric firms: model matches observed industry structure
Demand Estimation

1. Simultaneity problem

- Include brand-region dummies in $x_j$ to flexibly account for constant differences in product quality (Nevo, 2001)
- Instrument for prices using weather in Brazil and Colombia (major coffee producing countries)
  
  - Instruments explain about 1/3 of the variation in commodity prices

2. Heterogeneity

Allow for heterogeneity in price elasticities across consumers
## Demand Estimates

<table>
<thead>
<tr>
<th></th>
<th>OLS1</th>
<th>OLS2</th>
<th>IV1</th>
<th>IV2</th>
<th>IV3</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brand x Region</strong></td>
<td><strong>NO</strong></td>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
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<tr>
<td><strong>Region dummies</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Instrument</strong></td>
<td><strong>Hausman</strong></td>
<td><strong>Commodity Cost</strong></td>
<td><strong>Weather</strong></td>
<td><strong>Weather</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median Price Elasticity</strong></td>
<td><strong>0.54</strong></td>
<td><strong>1.96</strong></td>
<td><strong>3.02</strong></td>
<td><strong>2.69</strong></td>
<td><strong>3.20</strong></td>
<td><strong>3.46 [2.59 4.48]</strong></td>
</tr>
</tbody>
</table>
**Oligopoly Menu Cost Model**

**Demand Side**

Estimated random coefficients demand model

**Supply Side**

Focus on representative market (Syracuse)


Firm $j$ seeks to maximize the discounted expected sum of future profits

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[ \pi_{jt}(p_t^r, C_t) - \gamma_{jt} 1(\Delta p_{jt}^w \neq 0) \right],$$
Menu Costs: Assume that firms face a random menu cost $\gamma_{jt}$ of adjusting their prices

Asymmetric information: Firms do not know competitors’ menu costs when choosing prices (helps smooth policy functions)
Model Solution

In equilibrium every firm chooses prices optimally:

\[ p_t = \begin{cases} 
  p_{t-1} & \text{if } \Delta W < \gamma_t \\
  p^* & \text{otherwise}
\end{cases} \]  

(1)

where \( \Delta W = W_{ch} - W_{nch} \) and:

\[ p^* = \operatorname{arg\,max}_p E_t \left[ \pi(p, C) + \beta V_j(p, C, \gamma) \right]. \]  

(2)
Model Solution cont’d

Markov Perfect Equilibrium

– Assume strategies depend only on payoff-relevant variables

Solve using numerical methods (Pakes and Mcguire, 1994)

– Search for fixed point of policy functions across firms
– No guarantee of convergence, uniqueness
Figure 6: Probability of Adjustment as a Function of Competitors' Prices
Parameterization:

Use estimated demand system, local costs etc.

Estimate mean of menu cost distribution using simulated method of moments:

\[ \hat{\sigma} = \min_{\sigma} (f - \hat{f})^2 \]

- \(f\): Empirical frequency of wholesale price change
- \(\hat{f}\): Frequency of price change implied by the model given actual cost series

Commodity costs: random walk

Production function: partially known
Results

1. Markups

- Median percentage markup: 58.3%
  - Similar to Foster et al. (2005) for ground coffee

- Median fraction of local (non-coffee bean) costs: 52%
  - Similar to estimates on average fraction of non-coffee variable costs from the Survey of Manufacturers

Not clear that static estimates will equal dynamic estimates → Also consider alternative dynamic procedure
2. Menu Cost Estimates

Mean of menu cost: $\sigma = 0.22\%$ of average annual revenue

Smaller than existing estimates of average menu costs for supermarkets (Zbaracki et al., 2004)

Robustness check: estimate menu cost simultaneously with common component in costs as part of the dynamic estimation procedure: very similar results
3. Implications for Price Rigidity: Model vs. Data

- Model captures basic pattern in timing of price adjustments
- Somewhat less variation in frequency of price change implied by model vs. data
4. Implications for Pass-through: Model vs. Data

- Long-run pass-through is 0.269 in the model; 0.247 in the data
- Less than half of pass-through occurs in the first quarter
Accounting for Incomplete Pass-through:

Dixit-Stiglitz model

Dixit-Stiglitz model with local costs

Static random coefficients discrete choice model with local costs, mark-up adjustment

Oligopoly menu cost model with local costs, mark-up adjustment, menu costs
## Pass-through Regressions for Simulated Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dixit-Stiglitz (no local costs)</th>
<th>Dixit-Stiglitz (local costs)</th>
<th>Static Discrete Choice</th>
<th>Dynamic Discrete Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-run Pass-through</td>
<td>1</td>
<td>0.426</td>
<td>0.284</td>
<td>0.269</td>
</tr>
<tr>
<td>Factors:</td>
<td>Local Costs</td>
<td>Local Costs, Markup Adj.</td>
<td>Local Costs, Markup Adj. Menu Costs</td>
<td></td>
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<tr>
<td>Percent:</td>
<td>78%</td>
<td>20%</td>
<td>2%</td>
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</table>
Robustness:

Determinants of Pass-Through

- Persistence of marginal costs: Higher persistence ↑ PT
- Timing of price adjustments (menu cost vs. Calvo): Calvo ↓ PT
- Heterogeneity in price elasticities: Higher het. ↑ PT

Determinants of Price rigidity

- Persistence and volatility of marginal costs
- Forward-looking behavior
Conclusions

- Menu cost model provides quantitatively realistic account for pass-through, timing of price adjustments
- Dynamic model crucial for evaluating magnitude of menu costs, implications for pass-through
- Delays in pass-through occur almost entirely at the wholesale level
- Local costs and mark-up adjustment account for 78% and 20% of pass-through; while menu costs account for only 2%